

NEC-2370-US
Amendment dated 10/18/2004

09/853,622

04150012aa
Reply to office action mailed 08/18/2004

The following is a complete listing of all claims in the application, with an indication of the status of each:

Listing of claims:

- 1 1. (currently amended) A magnetoresistive effect sensor using a shielded-
2 type magnetoresistive effect element comprising:
3 a magnetoresistive effect film above a lower shield layer, said film
4 comprising a basic configuration that is a combination of a free layer, a barrier
5 layer, and a fixed layer, wherein either said barrier layer is formed on said free
6 layer, said free layer being an underlying layer for the barrier layer, and said
7 fixed layer is formed on said barrier layer, or said barrier layer is formed on
8 said fixed layer, said fixed layer being the underlying layer, and said free layer
9 is formed on said barrier layer, said barrier layer inheriting a roughness of said
10 lower shield layer, wherein a sensing current flows substantially
11 perpendicularly with respect to said magnetoresistive effect film, and wherein
12 either an amorphous material or a microcrystalline material is used in said
13 lower shield layer so as to smooth said lower shield layer, thereby increasing
14 the smoothness of said barrier layer.
- 1 2. (currently amended) A magnetoresistive effect sensor according to claim
2 1, wherein said lower shield layer comprises a crystal grain diameter of 6.2 nm
3 or smaller.
- 1 3. (currently amended) A magnetoresistive effect sensor according to claim 1
2 or claim 2, wherein said lower shield layer is made of a material of CoZrTa;
3 ~~with a~~ and CoZrTaCr alloy, said lower shield layer serving as a base layer for
4 said ~~free~~ underlying layer.

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1 4. (withdrawn) A magnetoresistive effect sensor according to claim 1,
2 wherein said lower shield is formed by means of sputtering.

1 5. (withdrawn) A magnetoresistive effect sensor according to claim 1,
2 wherein a magnetoresistive effect film having a basic configuration that is
3 either a combination of a free layer, a barrier layer formed on said free layer,
4 and a fixed layer formed on said barrier layer, or a combination of a fixed
5 layer, a barrier layer formed on said fixed layer, and a free layer formed on
6 said barrier layer is formed on said lower shield directly or formed thereon via
7 an intervening base layer.

1 6. (withdrawn) A magnetoresistive effect sensor according to claim 1,
2 wherein a lower conductor layer is disposed at a bottom part of a
3 magnetoresistive effect film having a basic configuration that is either a
4 combination of a free layer, a barrier layer formed on said free layer, and a
5 fixed layer formed on said barrier layer, or a combination of a fixed layer, a
6 barrier layer formed on said fixed layer, and a free layer formed on said barrier
7 layer, a bottom part of said lower conductor layer being in contact with a
8 lower shield.

1 7. (withdrawn) A magnetoresistive effect sensor wherein in a
2 magnetoresistive effect element in which a conductor layer is disposed at a
3 bottom part of a magnetoresistive effect film having a basic configuration that
4 is either a combination of a free layer, a barrier layer formed on said free layer,
5 and a fixed layer formed on said barrier layer, or a combination of a fixed
6 layer, a barrier layer formed on said fixed layer, and a free layer formed on
7 said barrier layer, in contact either with an intervening base layer or directly

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8 therewith, wherein said lower conductor layer functions as a lower electrode to
9 cause a sensing current to flow in said magnetoresistive effect film, and
10 further wherein a lower conductor is made of a material selecting from a group
11 consisting of an amorphous material and a microcrystal.

1 8. (withdrawn) A magnetoresistive effect sensor according to claim 7,
2 wherein said microcrystal forming said lower conductor layer comprises a
3 crystal grain diameter of 5.4 nm or smaller.

1 9. (withdrawn) A magnetoresistive effect sensor according to claim 7,
2 wherein said lower conductor layer is formed by sputtering.

1 10. (withdrawn) A magnetoresistive effect sensor according to claim 1,
2 further comprising a layer which fixes a magnetization of a fixed layer,
3 provided so as to be in contact with said fixed layer.

1 11. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor whereby a shielded-type magnetoresistive effect element in which a
3 sensing current flows substantially perpendicular to a magnetoresistive effect
4 film, using a magnetoresistive effect film having a basic configuration that is
5 either a combination of a free layer, a barrier layer formed on said free layer,
6 and a fixed layer formed on said barrier layer, or a combination of a fixed
7 layer, a barrier layer formed on said fixed layer, and a free layer formed on
8 said barrier layer, wherein a material selected from a group consisting of an
9 amorphous material and a microcrystalline material is used in a lower shield.

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- 1 12. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor according to claim 11, wherein said microcrystal used in said lower
3 shield comprises a crystal grain diameter of 6.2 nm or smaller.

- 1 13. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor according to claim 11, wherein said lower shield is formed using
3 sputtering.

- 1 14. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor according to claim 11, wherein a magnetoresistive effect film having a
3 basic configuration that is either a combination of a free layer, a barrier layer
4 formed on said free layer, and a fixed layer, or a combination of a fixed layer,
5 a barrier layer formed on said fixed layer, and a free layer is formed on said
6 lower shield directly or formed thereon via an intervening base layer.

- 1 15. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor according to claim 11, whereby a lower shield layer is formed and a
3 lower conductor layer is formed on said lower shield layer, and further
4 whereby a magnetoresistive effect film having a basic configuration that is
5 either a combination of a free layer, a barrier layer formed on said free layer,
6 and a fixed layer, or a combination of a fixed layer, a barrier layer formed on
7 said fixed layer, and a free layer formed on said barrier layer is formed on said
8 lower conductor layer, either directly or via an intervening base layer.

- 1 16. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor whereby a magnetoresistive effect film having a basic configuration
3 that is either a combination of a free layer, a barrier layer formed on said free
4 layer, and a fixed layer, or a combination of a fixed layer, a barrier layer

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5 formed on said fixed layer, and a free layer formed on said barrier layer is
6 formed either directly on a lower conductor layer or thereonto with an
7 intervening base layer, and further wherein, said lower conductor layer being
8 made of a material selected from a group consisting of an amorphous material
9 and a microcrystalline material.

1 17. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor according to claim 16, whereby said lower conductor layer is formed by
3 a microcrystal comprising a crystal grain diameter of 5.4 nm or smaller.

1 18. (withdrawn) A method for manufacturing a magnetoresistive effect
2 sensor according to claim 16, whereby said lower conductor layer is formed by
3 sputtering.

1 19. (withdrawn) A method for manufacturing a magnetoresistive effect film
2 according to claim 11, whereby a layer fixing a magnetization of a fixed layer
3 is further formed, so as to be in contact with said fixed layer.

1 20. (withdrawn) A magnetoresistance detection system comprising a
2 magnetoresistive effect sensor according to claim 1, a means for generating a
3 current passing through a magnetoresistive effect sensor, and means for
4 detecting a change in magnetoresistance of said magnetoresistive effect sensor
5 as a function of a detected magnetic field.

1 21. (withdrawn) A magnetic recording system comprising a magnetic storage
2 medium comprising a plurality of tracks for data recording, a magnetic
3 recording system for storing data on said magnetic storage medium, a
4 magnetoresistance detection system according to claim 20, and an actuating

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5 means lined to said magnetic recording system and a magnetoresistance
6 conversion system for the purpose of causing said magnetic recording system
7 and said magnetoresistance detection system to move to a selected track of
8 said magnetic storage medium.